

Amendments to the Claims

This listing of claims will replace all prior versions, and listings, of the claims:

1. (currently amended) A hierarchical method for fault tolerance in a distributed computer system:

providing a plurality of data centers;

providing a plurality of objects in each of the plurality of data centers;

providing a local sub-protocol within each data center;

using each local sub-protocol to disseminate messages within its own data center

to a plurality of local objects; and

~~using a local sub-protocol for dissemination of messages within a data center in the plurality of data centers; and~~

activating each of the local sub-protocols from another data center of the plurality of data centers in a single round-trip message in the absence of faults.

2. (original) The hierarchical method as claimed in claim 1 wherein:

using the local sub-protocol uses an atomic broadcast protocol.

3. (original) The hierarchical method as claimed in claim 1 wherein:

using the local sub-protocol uses an atomic broadcast protocol and invokes the plurality of objects in the data center.

4. (original) The hierarchical method as claimed in claim 1 wherein:

using the local sub-protocol uses an atomic broadcast protocol and invokes the plurality of objects in other of the plurality of data centers by sending propagation messages;

and including:

responding to the propagation message in the other of the plurality of data centers activates a local atomic broadcast protocol.

5. (original) The hierarchical method as claimed in claim 1 wherein:

using the local sub-protocol uses an atomic broadcast protocol and invokes the plurality of objects in other of the plurality of data centers by sending a propagation message;

and including:

responding to the propagation message in the other of the plurality of data centers includes providing an acknowledgement to the data center in the plurality of data centers from one of the plurality of objects therein.

6. (original) The hierarchical method as claimed in claim 1 wherein:

using the local sub-protocol uses an atomic broadcast protocol and invokes the plurality of objects in other of the plurality of data centers by sending a propagation message;

and including:

responding to the propagation message in the other of the plurality of data centers includes providing an acknowledgement to the data center in the plurality of data centers from one of the plurality of objects therein; and

waiting a time for the acknowledgement and sending a second propagation message to another of the plurality of objects in the other of the plurality of data centers if the acknowledgement is not received within the time.

7. (original) The hierarchical method as claimed in claim 1 wherein:

using the local sub-protocol uses an atomic broadcast protocol and invokes the plurality of objects in other of the plurality of data centers by sending a first propagation message;

and including:

responding to the first propagation message in the other of the plurality of data centers includes providing an acknowledgement to the data center in the plurality of data centers from one of the plurality of objects therein;

waiting a time for the acknowledgement and activating a second propagation message to another of the plurality of objects in the other of the plurality of data centers if the acknowledgement is not received within the time; and

sending the first and second propagation messages includes sending first and second unique identifiers.

8. (original) The hierarchical method as claimed in claim 1 wherein:

activating the local sub-protocol includes using a unique identifier.

9. (original) The hierarchical method as claimed in claim 1 wherein:

providing the plurality of objects includes providing a primary object in one of the plurality of data centers that communicates with the other of the plurality of data centers.

10. (original) The hierarchical method as claimed in claim 1 wherein:

using the local sub-protocol includes detecting failures within the plurality of objects within each of the plurality of data centers.

11. (original) The hierarchical method as claimed in claim 1 wherein:

using the local sub-protocol includes determining when faults occur in the plurality of objects in a local data center.

12. (original) The hierarchical method as claimed in claim 1 wherein:

using the local sub-protocol includes determining when faults occur in the plurality of objects in a local data center;

and including:

determining an alternate object in the plurality of objects in the local data center to become a backup primary object when a primary object has a fault.

13. (original) The hierarchical method as claimed in claim 1 wherein:

using the local sub-protocol includes developing a suspicion of the occurrence of faults in the plurality of objects in a local data center;

and including:

determining an alternate object in the plurality of objects in the local data center to become a backup primary object when a primary object has a fault.

14. (currently amended) A hierarchical method for fault tolerance in a distributed computer system:

providing a plurality of data centers;

providing a plurality of objects in each of the plurality of data centers;

providing a local sub-protocol within each data center, each local sub-protocol including an atomic broadcast protocol;

using each local sub-protocol for fault-tolerant dissemination of messages within its own data center to a plurality of local objects; and

~~using a local sub-protocol including an atomic broadcast protocol for fault-tolerant dissemination of messages within a data center in the plurality of data centers;~~
and

activating a plurality of the local sub-protocols from a single ~~another~~ data center of the plurality of data centers using a propagation message sent in a fault-tolerant manner in a single round-trip message in the absence of faults.

15. (original) The hierarchical method as claimed in claim 14 including:

responding to the propagation message in the other of the plurality of data centers includes providing an acknowledgement to the data center in the plurality of data centers from one of the plurality of objects therein.

16. (original) The hierarchical method as claimed in claim 14 including:

responding to the propagation message in the other of the plurality of data centers includes providing an acknowledgement to the data center in the plurality of data centers from one of the plurality of objects therein; and

waiting a time for the acknowledgement and sending a second propagation message to another of the plurality of objects in the other of the plurality of data centers if the acknowledgement is not received within the time.

17. (original) The hierarchical method as claimed in claim 14 including:

responding to the first propagation message in the other of the plurality of data centers includes providing an acknowledgement to the data center in the plurality of data centers from one of the plurality of objects therein;

waiting a time for the acknowledgement and sending a second propagation message to another of the plurality of objects in the other of the plurality of data centers if the acknowledgement is not received within the time; and

sending the first and second propagation messages includes sending first and second unique identifiers.

18. (original) The hierarchical method as claimed in claim 14 wherein:

activating the local sub-protocol includes using the propagation message with a unique identifier.

19. (original) The hierarchical method as claimed in claim 14 wherein:

using the local sub-protocol to determine when faults occur in the plurality of objects in a local data center;

and including:

determining an alternate object in the plurality of objects in the local data center to become a backup primary object when a primary object has a fault.

20. (original) The hierarchical method as claimed in claim 14 wherein:

using the local sub-protocol to developing a suspicion of the occurrence faults in the plurality of objects in a local data center;

and including:

determining an alternate object in the plurality of objects in the local data center to become a backup primary object when a primary object has a fault.

21. (new) A method, comprising:

- generating, by a first object in a first data center, a request to invoke other objects in a plurality of other data centers;

- relaying a message from the first data center to a receiver object in each of the plurality of data centers;

- activating, by the receiver object in each of the plurality of data centers, a broadcast protocol to disseminate the message locally to a plurality of objects within each of the plurality of data centers;

- waiting, by the first data center, for an acknowledgement message from each of the plurality of data centers to acknowledge receipt of the message;

- failing to receive, by the first data center, an acknowledgement message from one of the data centers; and

- resending the message from the first data center to a second receiver object in the one of the data centers after failing to receive, by the first data center, the acknowledgement message from the one of the data centers.

22. (new) The method of claim 21 further comprising:

- sending the message only once to each of the plurality of data centers that is not suspected of having a receiver object that is crashed;

- sending the message at least twice to each of the plurality of data centers that is suspected of having a receiver object that is crashed.

23. (new) The method of claim 21 wherein a second object in the first data center relays the message to each of the plurality of data centers.

24. (new) The method of claim 23 further comprising:

- suspecting, within the first data center, a crash of the second object;

- broadcasting, within the first data center, a suspicion of the crash to a plurality of objects in the first data center;

- agreeing, by the plurality of objects in the first data center, upon the suspicion.

25. (new) The method of claim 24 further comprising:

designating, by the plurality of objects in the first data center, a third object to relay messages to each of the plurality of data centers.

26. (new) The method of claim 25 further comprising:

ensuring, by the third object, that all messages that were designated to be sent to other data centers by the second object are in fact sent to the other data centers.